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(71) Applicant(s)

New Transducers Limited  
(Incorporated in the United Kingdom)  
Ixworth House, 37 Ixworth Place, LONDON,  
SW3 3QH, United Kingdom

(72) Inventor(s)

Neil Simon Owen

(74) Agent and/or Address for Service

Maguire Boss  
5 Crown Street, ST IVES, Cambridgeshire, PE27 5EB,  
United Kingdom

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(56) Documents Cited

GB 2335294 A GB 2333005 A WO 98/43464 A1  
WO 97/09842 A1 WO 96/01547 A2 WO 95/31805 A1  
US 5796854 A

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UK CL (Edition S ) G4A ADT , H4J JA JK  
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(54) Abstract Title

**PDA having a bending wave loudspeaker**

(57) A personal data assistant 1 adapted for making and receiving voice calls between a user of the personal data assistant and a remote caller, the personal data assistant comprising a transceiver for sending and receiving voice calls, a microphone 19 connected to the transceiver so that voice received on the microphone is sent to the remote caller and a loudspeaker 21 integrated in the personal data assistant and connected to the transceiver so that voice received from the remote caller is outputted by the loudspeaker. The loudspeaker 21 may be a bending wave or distributed mode speaker comprising an acoustic radiator 23 capable of supporting bending waves and a transducer 27 mounted on the acoustic radiator to excite bending waves in the acoustic radiator to produce an acoustic output.

Fig.1

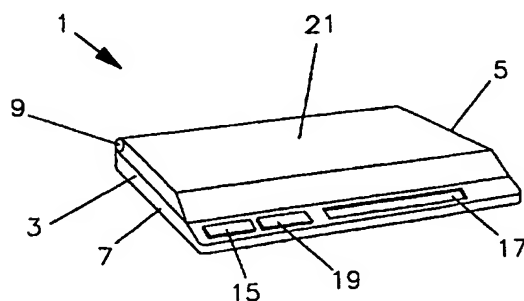
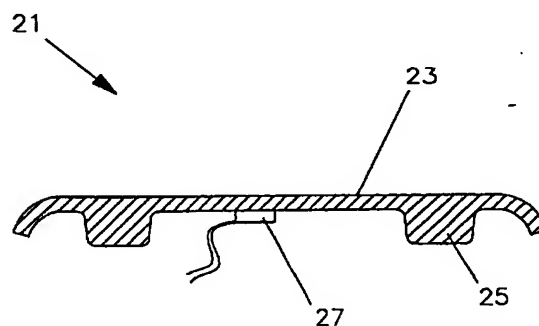


Fig.3



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Fig.1

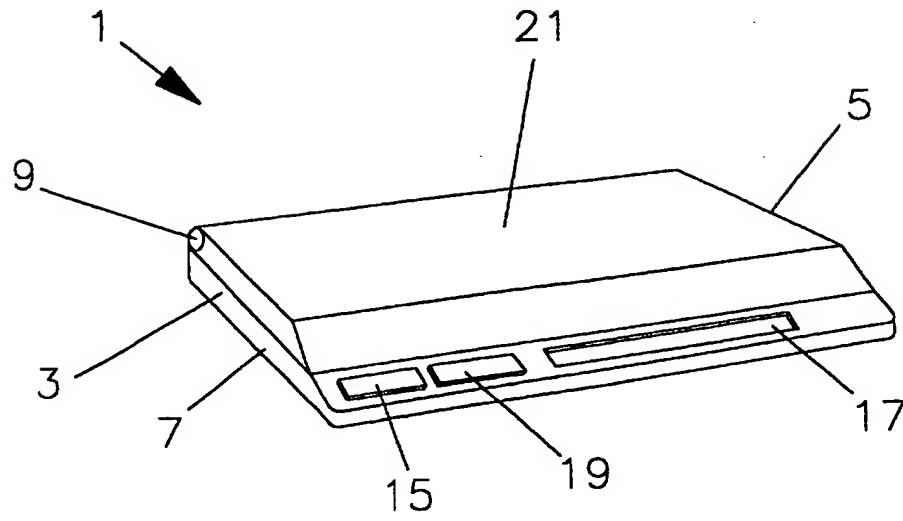


Fig.2

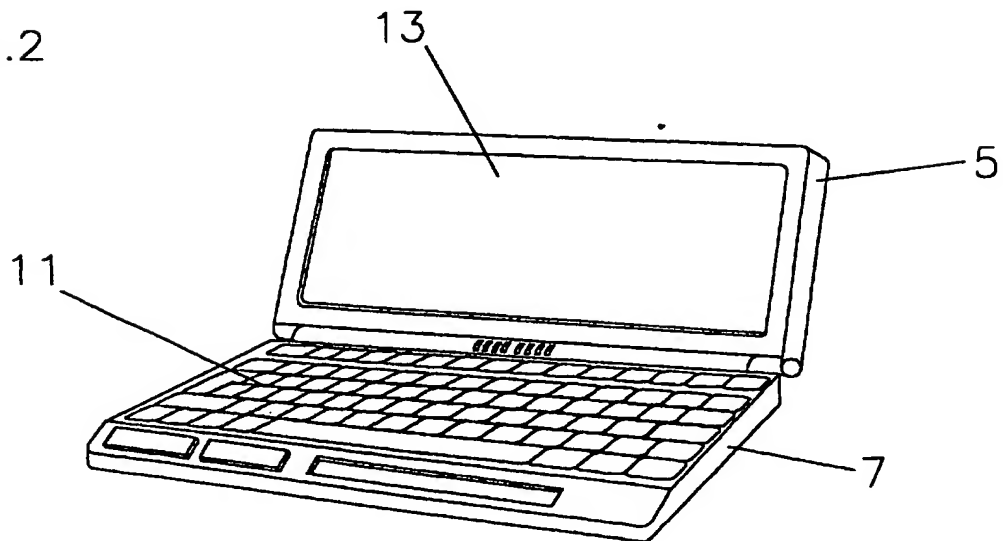
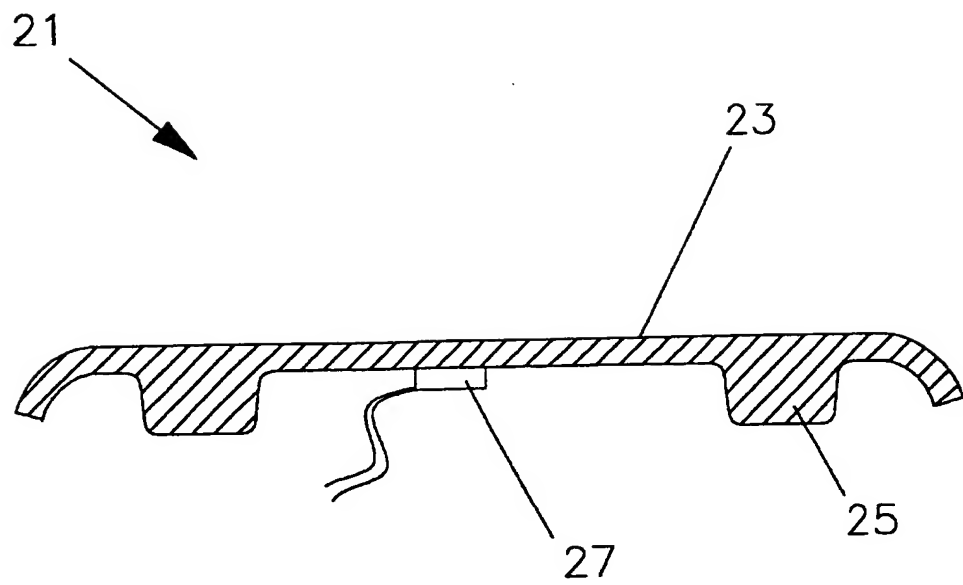


Fig.3



5           TITLE: ELECTRONIC APPARATUS HAVING LOUDSPEAKER

DESCRIPTION

10   TECHNICAL FIELD

          The invention relates to electronic apparatus, particularly to portable computers of the type known as personal data assistants or palmtops.

BACKGROUND ART

15           Recently, a number of manufacturers have started to sell small devices known as personal data assistants (PDAs) which record diary entries, act as an address book and can have a number of other functions as required. A similar concept is the palmtop computer, which is  
20   generally a multi-functional device with a small keyboard that can carry out many of the functions of a larger computer but that is small, light and portable.

          The growth of mobile telephony, and in particular cellular telephones, has provided a network that can be  
25   used in many locations. This technology has recently resulted in a number of products that combine palm top computers with cellular telephony so that emails can be sent and received by a portable device using wireless

communication. The Symbian (trade mark) consortium is particularly active in this area. Also sold are mobile telephones that have the capability to send and receive email.

5           However, additional functionality could usefully be incorporated into such personal data assistants, to improve their versatility. It should be noted that in this application the term "personal data assistant" is intended to include palm tops and other similar portable computers.

10

#### DISCLOSURE OF INVENTION

          According to the invention there is provided a personal data assistant adapted for making and receiving voice calls between a user of the personal data assistant and a remote caller, the personal data assistant  
15           comprising a transceiver for sending and receiving voice voice calls, a microphone connected to the transceiver so that voice received on the microphone is sent to the remote caller and a loudspeaker integrated in the personal  
20           data assistant and connected to the transceiver so that voice received from the remote caller is outputted by the loudspeaker.

          The personal data assistant may be adapted for conference calls between the user of the personal data  
25           assistant and more than one remote callers. The transceiver may also be adapted to receive and transmit electronic data or electronic mail. The transceiver may be connected to a mobile telephone network.

The loudspeaker may be a bending wave speaker comprising an acoustic radiator capable of supporting bending waves and a transducer mounted on the acoustic radiator to excite bending waves in the acoustic radiator to produce an acoustic output. It is preferred to use as the loudspeaker a resonant bending wave mode loudspeaker having an acoustic radiator and a transducer fixed to the acoustic radiator for exciting resonant bending wave modes. Such a loudspeaker is described in WO98/09842 and other patent applications and publications and may be referred to as a distributed mode loudspeaker.

The properties of the acoustic radiator may be chosen to distribute the resonant bending wave modes substantially evenly in frequency. In other words, the properties or parameters, e.g. size, thickness, shape, material etc., of the acoustic radiator may be chosen to smooth peaks in the frequency response caused by "bunching" or clustering of the modes. The resultant distribution of resonant bending wave modes may thus be such that there are substantially minimal clusterings and disparities of spacing.

In particular, the properties of the acoustic radiator may be chosen to distribute the lower frequency resonant bending wave modes substantially evenly in frequency. The distribution of resonant bending wave modes is less dense at lower frequency than at higher frequency and thus the distribution of the lower frequency resonant bending wave modes is particularly

important. The lower frequency resonant bending wave modes are preferably the ten to twenty lowest frequency resonant bending wave modes of the acoustic radiator. For an acoustic radiator for use in a personal data  
5 assistant, the lower frequency resonant bending wave modes may all be below 2 kHz - IS THIS TRUE?

The resonant bending wave modes associated with each conceptual axis of the acoustic radiator may be arranged to be interleaved in frequency. Each conceptual axis has  
10 an associated lowest fundamental frequency (conceptual frequency) and higher modes at spaced frequencies. By interleaving the modes associated with each axis, the substantially even distribution may be achieved. There may be two conceptual axes and the axes may be symmetry  
15 axes. For example, for a rectangular acoustic radiator, the axes may be a short and a long axis parallel to a short and a long side of the acoustic radiator respectively. For an elliptical acoustic radiator, the axes may correspond to the major and minor axis of the  
20 ellipse. The axes may be orthogonal.

The transducer location may be chosen to couple substantially evenly to the resonant bending wave modes. In particular, the transducer location may be chosen to couple substantially evenly to lower frequency resonant  
25 bending wave modes. In other words, the transducer may be mounted at a location spaced away from nodes (or dead spots) of as many lower frequency resonant modes as possible. Thus the transducer may be at a location where

the number of vibrationally active resonance anti-nodes is relatively high and conversely the number of resonance nodes is relatively low. Any such location may be used, but the most convenient locations are the near-central  
5 locations between 38% to 62% along each of the length and width axes of the panel, but off-central. Specific locations found suitable are at  $3/7, 4/9$  or  $5/13$  of the distance along the axes; a different ratio for the length axis and the width axis is preferred.

10 The transducer may be grounded or partially grounded. The transducer may be piezoelectric. A piezoelectric transducer mounted on the casing of the personal data assistant might produce a satisfactory buzzing sound but distributed mode technology as  
15 described above may improve the clarity of reproduced speech.

The acoustic radiator may have selected values of certain physical parameters which enable the acoustic radiator to sustain and propagate input vibrational  
20 energy in a predetermined frequency range by a plurality of resonant bending wave modes in a least one operative area extending transversely of thickness such that the frequencies of the resonant bending wave modes along at least two conceptual axes of the operative area are  
25 interleaved and spread so that there are substantially minimal clusterings and disparities of spacings of said frequencies, the acoustic radiator when resonating have at least one site at which the number of vibrationally



active resonance anti-nodes is relatively high and a transducer mounted wholly and exclusively on the acoustic radiator at one of said sites on the acoustic radiator, the transducer being capable of vibrating the acoustic radiator in the predetermined frequency range to couple to and excite the resonant bending wave modes in the acoustic radiator and cause the acoustic radiator to resonate and produce an acoustic output.

The acoustic radiator may be in the form of a panel. The panel may be flat and may be lightweight. The material of the acoustic radiator may be anisotropic or isotropic.

The personal data assistant may have a casing and the loudspeaker may be integrally formed with the casing. In particular, the panel may be formed integrally with the casing. Alternatively, the loudspeaker may be formed as a separate component and then attached to the casing so that it is integral therewith. The loudspeaker may be attached to the casing by a resilient mounting or alternatively a rigid fixing.

Preferably the personal data assistant comprises a base and a lid hinged to the base. The loudspeaker may be integrated in the casing of the lid. The loudspeaker may be formed integrally with the casing of the lid. Alternatively, the loudspeaker may be separately made and subsequently mounted in a suitable space in the lid. The mounting may be either resilient or rigid.

Thus, the acoustic radiator may be integrated in the

personal data assistant without adding too much to the size and weight of the personal data assistant. In contrast, a conventional pistonic loudspeaker is likely to add too much to the size and weight of the personal data assistant to be practical in portable applications.

The loudspeaker may be a combined loudspeaker and microphone system, thus eliminating the need for a separate microphone.

The personal data assistant may further comprise a data-inputting device, for example, in the form of an alphanumeric keyboard or alternatively in the form of a touch sensitive screen. Data inputted in to the personal data assistant may be visible in a display screen. The display screen may be integrated into the lid of the personal data assistant and may only be visible when the lid is opened. The display screen may display information relating to the telephone call, e.g. name, number and other details relating to the remote caller(s). The transceiver may also be adapted to receive video information enabling video images of the remote caller to be displayed in the display screen.

The personal data assistant may further comprise a call display for displaying information relating to the telephone call. The call display may be mounted externally on the casing of the personal data assistant so that information relating to the call is visible. In particular, for personal data assistants comprising a lid, so that information relating to the call is visible when

the lid is closed. The call display may be a conventional liquid crystal display.

The personal data assistant may further comprise a connector button such that the user may accept an incoming call simply by pressing the connector button. The connector button may be mounted externally on the casing of the personal data assistant so that the connector button is easily accessible. In particular, for personal data assistants comprising a lid, so that the connector button is accessible when the lid is closed.

In the case that both the connector button and call display are mounted on the outside of the personal data assistant, there is no need for the user to open the personal data assistant to make and receive telephone calls. However, the call display and the connector button, may be omitted if not required; their functionality may be incorporated into the display screen and the data-inputting device.

#### BRIEF DESCRIPTION OF DRAWINGS

For a better understanding of the invention a specific embodiment will now be described, purely by way of example, with reference to the accompanying drawings, in which

Figure 1 shows a perspective view of an embodiment of a personal data assistant in its closed configuration,

Figure 2 shows a perspective view of the embodiment of Figure 1 in its open configuration, and

Figure 3 illustrates the distributed mode

loudspeaker.

BEST MODES FOR CARRYING OUT THE INVENTION

Figures 1 and 2 show a personal data assistant 1 having a casing 3 comprising a lid 5 attached to a base 7 by a hinge 9. The lid 5 can be moved from a closed position (Fig. 1) adjacent to the base 7 to an open position (Fig. 2).

The inside of the base 7 contains a keyboard 11 for inputting data into the personal data assistant. The inside of the lid 5 comprises a display screen 13 for displaying information contained within the personal data assistant. When the lid is opened the personal data assistant can function as a conventional personal data assistant for example, for storage and manipulation of inputted data.

The outside of the base 7 also includes a connector button 15, a microphone 19 and a call display 17 which is implemented as a conventional liquid crystal display. The base contains a transceiver for sending and receiving voice and data telephone calls. Such calls may be transmitted over a mobile telephone network.

A loudspeaker 21 is integrated in the lid 5 by being integrally formed with it. Figure 3 shows the features of the loudspeaker more clearly. The loudspeaker has a panel 23 defined by ribs 25 integral with the lid 5. The panel 23 has its properties, for example its geometric shape, chosen so that the resonant bending wave modes in a predetermined frequency range are as evenly distributed

in frequency as is practicable. This may be done by arranging the modes associated with the length of the personal data assistant to be interleaved with those associated with the width of the personal data assistant.

5       A transducer 27 is mounted on the panel 23, close to but not at its centre, to excite it to produce an acoustic output. The transducer is mounted at a location on the panel to couple substantially evenly to resonant bending wave modes in the panel. Such a loudspeaker 21 is  
10       described in WO98/09842 and other patent applications and publications and may be referred to as a distributed mode loudspeaker.

The personal data assistant may function as a conference telephone as follows:

- 15       a) When an incoming voice call is detected, the number is displayed on the call display.
- b) If the connector button is pressed the incoming call is accepted.
- c) The personal data assistant then operates as a  
20       loudspeaker telephone using the loudspeaker 21 and the microphone 19. The user's voice is received on the microphone 19 and sent to the remote caller via the transceiver. Similarly, voice received from the remote caller via the transceiver is outputted by the loudspeaker  
25       21.

The provision of the connector button 15 and call display 17 so that they are visible when the lid is closed makes it possible to operate the unit as a conference

telephone when the lid is closed.

INDUSTRIAL APPLICABILITY

The invention thus provides an improved personal data assistant which may be used as a conference telephone.

CLAIMS

1. A personal data assistant adapted for making and receiving voice calls between a user of the personal data assistant and a remote caller, the personal data assistant comprising a transceiver for sending and receiving voice voice calls, a microphone connected to the transceiver so that voice received on the microphone is sent to the remote caller and a loudspeaker integrated in the personal data assistant and connected to the transceiver so that voice received from the remote caller is outputted by the loudspeaker.
2. A personal data assistant according to claim 1, wherein the loudspeaker is a bending wave speaker comprising an acoustic radiator capable of supporting bending waves and a transducer mounted on the acoustic radiator to excite bending waves in the acoustic radiator to produce an acoustic output.
3. A personal data assistant according to claim 1 or claim 2, wherein the loudspeaker is a resonant bending wave mode loudspeaker having an acoustic radiator and a transducer fixed to the acoustic radiator for exciting the resonant bending wave modes.
4. A personal data assistant according to claim 3, wherein the properties of the acoustic radiator are chosen to distribute the resonant bending wave modes substantially evenly in frequency.
5. A personal data assistant according to claim 3 or claim 4, wherein the resonant bending wave modes

associated with a first conceptual axis of the acoustic radiator are arranged to be interleaved in frequency with the resonant bending wave modes associated with a second conceptual axis.

5 6. A personal data assistant according to any one of claims 3 to 5, wherein the transducer location couples substantially evenly to the resonant bending wave modes.

7. A personal data assistant according to any one of claims 2 to 6, wherein the acoustic radiator is in the  
10 form of a panel.

8. A personal data assistant according to claim 7, wherein the panel is flat.

9. A personal data assistant according to any one of the preceding claims, wherein the personal data assistant has  
15 a casing and the loudspeaker is integrally formed with the casing.

10. A personal data assistant according any one of the preceding claims, wherein the personal data assistant comprises a base and a lid hinged to the base and the  
20 loudspeaker is integrated in the casing of the lid.

11. A personal data assistant according to any one of the preceding claims further comprising a data-inputting device and a display screen integrated into the lid of the personal data assistant.

25 12. A personal data assistant according to any one of the preceding claims further comprising a call display for displaying information relating to the telephone call.

13. A personal data assistant according to claim 12,



wherein the call display is mounted externally on the casing of the personal data assistant so that information relating to incoming calls is visible.

14. A personal data assistant according to any one of the  
5 preceding claims further comprising a connector button such that the user may accept an incoming call simply by pressing the connector button.

15. A personal data assistant according to claim 14,  
10 wherein the connector button is mounted externally on the casing of the personal data assistant so that the connector button is accessible.

16. A personal data assistant according to any one of the preceding claims, wherein the transceiver is adapted to receive video information enabling video images of the  
15 remote caller to be displayed in the display screen.

17. A personal data assistant according to any one of the preceding claims, further adapted for conference calls between the user of the personal data assistant and more than one remote callers.



Application No: GB 0025397.1  
Claims searched: 1 to 17

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Examiner: Peter Easterfield  
Date of search: 24 April 2001

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G4A (ADT); H4J (JA, JK)

Int Cl (Ed.7): G06F 1/16

Other: Online: WPI, EPODOC, JAPIO

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB 2335294 A (MATSUSHITA)	1-13 at least
Y	GB 2333005 A (SIEMENS)	1-13 at least
Y	US 5796854 A (MARKOW)	1-13 at least
Y	WO 98/43464 A1 (NEW TRANSDUCERS)	1-13 at least
Y	WO 97/09842 A1 (NEW TRANSDUCERS) see figs 27 & 28	1-13 at least
Y	WO 96/01547 A2 (NOISE CANCELLATION)	1-13 at least
Y	WO 95/31805 A1 (NOISE CANCELLATION) see page 6 lines 2 to 4	1-13 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.